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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification <sup>7</sup> :	A1	(11) International Publication Number:	WO 00/19769
H04R 25/00, B29C 70/60		(43) International Publication Date:	6 April 2000 (06.04.00)

(21) International Application Number: PCT/EP99/06700

(22) International Filing Date: 9 September 1999 (09.09.99)

(30) Priority Data:  
98203228.6 25 September 1998 (25.09.98) EP

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(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published

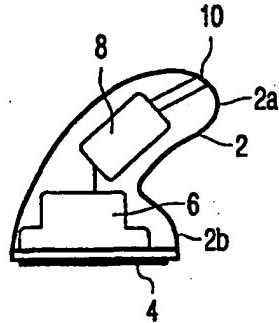
*With international search report.*

*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: OTOPLASTIC FOR A HEARING AID

(57) Abstract

An otoplastic for a hearing aid, which otoplastic is manufactured from a UV light-curable synthetic resin composition, in particular an acrylate composition, to which a ceramic filler including at least 50 % by weight Al<sub>2</sub>O<sub>3</sub> is added to improve the properties of the otoplastic.



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Otoplastic for a hearing aid.

The invention relates to an otoplastic for a hearing aid, which otoplastic comprises a UV light-cured synthetic resin composition.

The invention further relates to a method of manufacturing an otoplastic, in which method use is made of an UV light-curable synthetic resin composition which, after it has been introduced into a mould, is irradiated with UV light.

5 The inventioin also relates to a hearing aid provided with an otoplastic.

A method of manufacturing an otoplastic is disclosed in DE-A 3712578. In this known method, an individual otoplastic is manufactured by using a transparent mould which is made by using a model of an auditory duct of a patient. A polymerizable, UV light-curable 10 synthetic resin, to which colorants with opaque properties are added so as to adjust the penetration depth of UV light, is poured into the mould, whereafter polymerization takes place under the influence of UV light. For the UV light-curable synthtic resin use is made of an acrylate/methacrylate.

An otoplastic thus obtained has a number of drawbacks. One of the 15 drawbacks relates to its limited mechanical strength, as a result of which the otoplastic might easily fracture when it is dropped or knocked. In addition, the colorants used in the otoplastic often cause allergic reactions with patients, such as swelling, inflammation, redness of the ears and itching in the vicinity of the ears.

It is an object of the invention to provide an otoplastic which does not have the 20 above-mentioned drawbacks.

In order to achieve this object the otoplastic in accordance with the invention is characterized in that the UV light-cured synthetic resin composition is provided with a ceramic filler comprising at least 50% by weight  $\text{Al}_2\text{O}_3$  (aluminium trioxide). Said otoplastic may be used in various types of hearing aids, such as behind-the-ear hearing aids and in-the-ear 25 hearing aids. The otoplastic is a hollow envelope which, when used in a hearing aid, serves as a housing or a shell, dependent upon the type of hearing aid.

In experiments it has been found that an otoplastic in which the synthetic resin composition is provided with the desired quantity of said ceramic filler is very resistant to shocks caused by knocking or dropping the otoplastic, i.e., it is robust. In the course of the

manufacture of the otoplastic, the  $\text{Al}_2\text{O}_3$  used is also responsible for the setting of the penetration depth of UV light. As a result, the addition of a colorant to the synthetic resin composition can be omitted. In order to counteract allergic reactions, preferably, the otoplastic in accordance with the invention does not contain colorants.

5 An embodiment of the otoplastic in accordance with the invention is characterized as defined in claim 2. A UV light-curable acrylate composition provided with a ceramic filler containing at least 50% by weight  $\text{Al}_2\text{O}_3$  has very suitable properties for use as the starting material for the manufacture of an otoplastic. Acrylate, to which a photoinitiator is added for the curing process, is a colorless substance. After the addition of  $\text{Al}_2\text{O}_3$  and, 10 subsequently, curing, an otoplastic having a chalk-white surface is obtained. Due to its clinical effect, such a surface has the advantage that soilage is rapidly detected, which has a favorable effect on the hygienic use of the otoplastic which, in turn, favorably influences the service life of the otoplastic and hence of the hearing aid in which the otoplastic is employed.

15 An embodiment of the otoplastic in accordance with the invention is characterized as defined in claim 3. It has been found that a UV light-curable synthetic resin composition, in particular an acrylate composition to which 1 to 10% by weight of a ceramic filler including at least 50% by weight  $\text{Al}_2\text{O}_3$  are added, yields an otoplastic having a substantial mechanical strength. An optimum strength is obtained if the content of the ceramic filler is 5% by weight or substantially 5% by weight.

20 An embodiment of the otoplastic in accordance with the invention is characterized as defined in claim 5. The degree to which  $\text{SiO}_2$ ,  $\text{TiO}_2$  and  $\text{CaCO}_3$  are used, is determined by the desired properties of the otoplastic. Although the percentages may be varied within wide limits, for example, to define the penetration depth of UV light during curing, the percentages by weight are customarily close to five.

25 The method in accordance with the invention is characterized in that before the UV light-curable synthetic resin composition is introduced into the mould, a ceramic filler including at least 50% by weight  $\text{Al}_2\text{O}_3$  is admixed with the synthetic resin composition. By way of explanation, it is noted that, in the present description or claims, the term UV light is to be understood to mean radiation originating from a radiation source having an emission maximum of (approximately) 360 nm. The otoplastic manufactured in accordance with the method of the invention has the above-mentioned properties and advantages. The method also 30 has the advantage that it can be carried out using existing equipment which is known per se.

It is noted that EP-A 0498592 discloses a colored hearing-aid shell, which is manufactured from a visible light-curable synthetic resin composition including a filler of

titanium oxide, silicon dioxide or potassium titanate, and a colorant. During curing said composition, visible light having a wavelength of 450 nm is used. Both the manufacturing method used and the resultant product differ, in essential features, from the method and the otoplastic in accordance with the invention.

5 Preferably, in the method in accordance with the invention, an UV light-curable acrylate composition is used as the synthetic resin composition. A suitable acrylate is, for example, methacrylate or urethane acrylate. Preferably, also a quantity of a ceramic filler corresponding to 1 to 10% by weight of the synthetic resin composition, in particular the UV light-curable acrylate composition, is added. To achieve optimum results, 5% by weight is preferred. At least one of the materials  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{CaCO}_3$  may be added to the ceramic filler 10 in order to influence, in accordance with the requirements, specific properties of the composition and/or the otoplastic to be manufactured.

15 The invention further aims at providing a hearing aid which is provided with a sturdy otoplastic and which is comfortable to use.

15. To achieve this, the hearing aid in accordance with the invention is provided with the otoplastic according to the invention or is manufactured in accordance with the method of the invention.

20 As regards the claims, it is noted that various combinations of characteristics defined in the dependent claims are possible.

20. These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

In the drawings:

25 Fig. 1 is a diagrammatic, longitudinal sectional view of an embodiment of the otoplastic in accordance with the invention, and

Fig. 2 is a diagrammatic, longitudinal sectional view of an embodiment of the hearing aid in accordance with the invention.

The otoplastic shown in Fig. 1 serves as a housing for an in-the-ear hearing aid. 30 Said otoplastic is a hollow body 1 whose external shape is adapted to a patient's external auditory duct, particularly a part thereof situated near the eardrum. The otoplastic in this example is made from a UV light-curable acrylate composition which is provided with a ceramic filler including at least 50% by weight  $\text{Al}_2\text{O}_3$ , in this example approximately 70% by weight. The otoplastic is manufactured by means of a model of the external auditory duct.

Such a model serves as the basis for making a mould in which said composition provided with ceramic filler is introduced. The composition, to which a suitable initiator is added for curing, is subsequently irradiated with UV light, in which process a layer of the composition bordering on the mould is cured so as to form the hollow body 1. The UV light is supplied by 5 a radiation lamp having an emission maximum at 360 nm. After completion of the radiation process, the non-cured part of the composition is removed, and subsequently the moulded body 1 formed is cured further and removed from the mould.

Before the synthetic resin composition used in the method in accordance with the invention is introduced into the mould, it is admixed with a quantity of a ceramic filler, 10 which quantity corresponds to 1 to 10% by weight, in this example approximately 5% by weight, of the synthetic resin composition. Apart from  $\text{Al}_2\text{O}_3$ , the ceramic filler may comprise additives such as  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{CaCO}_3$ .

The in-the-ear hearing aid shown in Fig. 2 is provided with the otoplastic shown in Fig. 1. This otoplastic constitutes a housing 2 having a relatively thin wall. Said housing 2, 15 which is closed by a mounting plate 4, accommodates components which are known per se, such as a microphone, an amplifier device 6, a battery and an electro-acoustic converter 8. In accordance with the shape of an auditory duct, the housing 2 has a relatively narrow portion 2a and a relatively wide portion 2b. In the portion 2a, there is an aperture 10 for guiding acoustic signals to the exterior, and in the portion 2b there is an aperture for guiding sound signals to 20 the microphone.

It is noted that the invention is not limited to the examples shown herein. For example, the shape of the otoplastic may differ from that shown herein. Also, the hearing aid may be of a type which differs from the in-the-ear hearing aid.

## CLAIMS:

1. An otoplastic for a hearing aid, which otoplastic comprises a UV light-cured synthetic resin composition, characterized in that the UV light-cured synthetic resin composition is provided with a ceramic filler comprising at least 50% by weight  $\text{Al}_2\text{O}_3$  (aluminium trioxide).  
5
2. An otoplastic as claimed in claim 1, characterized in that the synthetic resin composition includes an UV light-cured acrylate composition.
3. An otoplastic as claimed in claim 1 or 2, characterized in that the ceramic-filler content in the synthetic resin composition ranges between 1 and 10% by weight.  
10
4. An otoplastic as claimed in claim 3, characterized in that the ceramic-filler content is at least substantially 5% by weight.
- 15 5. An otoplastic as claimed in claim 1 or 2, characterized in that the ceramic filler comprises, in addition to  $\text{Al}_2\text{O}_3$ , at least one of the following materials:  $\text{SiO}_2$  (silicon dioxide),  $\text{TiO}_2$  (titanium dioxide),  $\text{CaCO}_3$  (calcium carbonate).
- 20 6. A method of manufacturing an otoplastic, in which an UV light-curable synthetic resin composition is used as the starting material, which is irradiated with UV light after it has been introduced into a mould, characterized in that before the UV light-curable synthetic resin composition is introduced into the mould, a ceramic filler including at least 50% by weight  $\text{Al}_2\text{O}_3$  is admixed with the synthetic resin composition.  
25
7. A method as claimed in claim 6, characterized in that an UV light-curable acrylate composition is used as the synthetic resin composition.

8. A method as claimed in claim 6 or 7, characterized in that a quantity of a ceramic filler corresponding to 1 to 10% by weight of the synthetic resin composition is added.
- 5 9. A method as claimed in claim 6 or 7, characterized in that at least one of the materials  $\text{SiO}_2$ ,  $\text{TiO}_2$ ,  $\text{CaCO}_3$  is added to the ceramic filler.
10. 10. A hearing aid comprising an otoplastic as defined in any one of the claims 1 through 5, or manufactured in accordance with the method as defined in any one of the claims 6 through 9.

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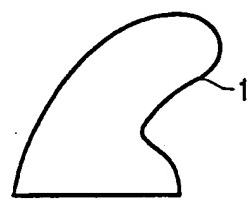


FIG. 1

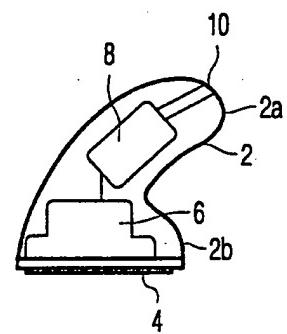


FIG. 2

# INTERNATIONAL SEARCH REPORT

International Application No  
PCT/EP 99/06700

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04R25/00 B29C70/60

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H04R B29C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 96 15179 A (KERR CORP) 23 May 1996 (1996-05-23)	1,6,10
A	page 1, line 7 - line 8 page 6, line 4 -page 7, line 9 page 7, line 19 -page 15, line 2 page 10 - page 11, example 3	2,7
Y	WO 88 03740 A (EPIC CORP) 19 May 1988 (1988-05-19)	1,6,10
A	page 6, line 25 -page 7, line 15	3-5,8,9
A	US 5 045 266 A (MORO DANIEL G ET AL) 3 September 1991 (1991-09-03) column 7, line 41 -column 8, line 7	1-10
		-/-

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

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Date of the actual completion of the international search

Date of mailing of the international search report

7 February 2000

14/02/2000

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 656 385 A (NIPPON PETROCHEMICALS CO LTD) 7 June 1995 (1995-06-07) page 8, line 28 - line 55 page 9, line 7 - line 19 -----	1-10
A	EP 0 088 845 A (SECR SOCIAL SERVICE BRIT) 21 September 1983 (1983-09-21) page 1, line 11 - line 14 page 6, line 7 - line 15 -----	1-10

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/06700

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
WO 9615179	A 23-05-1996	DE 753028 T		30-04-1997
		EP 0753028 A		15-01-1997
		JP 9504572 T		06-05-1997
WO 8803740	A 19-05-1988	US 4811402 A		07-03-1989
		AU 1087288 A		01-06-1988
		CA 1307579 A		15-09-1992
		US 5068902 A		26-11-1989
US 5045266	A 03-09-1991	NONE		
EP 0656385	A 07-06-1995	US 5663276 A		02-09-1997
		WO 9429365 A		22-12-1994
		JP 7062071 A		07-03-1995
		JP 7060917 A		07-03-1995
		JP 7063347 A		07-03-1995
EP 0088845	A 21-09-1983	GB 2107341 A,B		27-04-1983